4.0 HAZARD SPECIFIC DISCUSSION

Four hazard areas of concern have been identified for the FCP site (See Figure 4.0b). These hazards are components of the RBES Vision that vary from the current agreements. The selected remedial strategies for the hazards are designed to be protective of human health and the environment.

The following sections describe the hazard areas and the selected remedial strategies in detail. In addition, maps, CSM, and narratives have been developed to depict each of the hazard areas. **(Please Note: The CSM development process outlined in the RBES Guidance indicates that for a given hazard all possible exposure mechanisms and receptors be depicted on the CSM even if the barrier or intervention that has/will be implemented will limit or eliminate the exposure mechanism or risk to the receptor.)**

4.1 HAZARD AREA 1 – ON-SITE DISPOSAL FACILITY

Background

Through Fernald's five RODs, it was decided that the site's smaller volume of more highly contaminated material will be disposed off site and the larger volume of material with low levels of contamination that can be safely contained will be disposed on site. The OSDF is a result of this "balanced approach" to waste management at Fernald. Excavated soil and debris will be disposed in the OSDF, or if it does not meet the on-site WAC, at an off-site disposal facility.

The OSDF WAC are derived from the FEMP RODs and from the OSDF remedial design requirements (for physical WAC and prohibited items). Although there are WAC concentrations for individual constituents, the WAC for total Uranium at 1,030 ppm is commonly cited since it is the predominant contaminant at the site and will drive most soil excavation (DOE, 1998). The WAC has been developed so that the OSDF will be protective at a risk level of 1×10^{-7} to an end-user of the FCP.

Combined with waste streams from other site remediation activities, a total of 2.5 million cubic yards of soil and debris will be placed in the OSDF. Approximately 85% of the material destined for the OSDF will be soil and soil-like material and the remaining 15% will be debris from the demolition of site buildings. In accordance with Fernald's RODs, the OSDF will only accept wastes from the Fernald Site. The primary material types destined for the OSDF include all contaminated in-place soil and soil stockpiles; the waste materials persent in the South Field, Active and Inactive Flyash Piles, the Lime Sludge Ponds, and the Solid Waste Landfill; and the debris resulting from sitewide facility decontamination and dismantlement (D&D) efforts.

RBES

The OSDF will be an eight-cell, 75-acre, fenced facility left on the FCP site after site closure (See Figure 4.1b1). The OSDF will be capped with an engineered cover. The liner will have leak detection and leachate collection and transmission systems. A buffer zone and perimeter fence will be established around the disposal facility. The OSDF and buffer zone will remain DOE property in perpetuity in order to allow DOE to continue maintenance and monitoring of the facility. In the event that DOE transfers management of the OSDF to another federal government entity, the appropriate restrictions and limitations will be communicated and implemented (e.g., deed restrictions). The OSDF fence will be maintained by DOE in perpetuity.

The OSDF WAC will be applied to materials with the consideration of the average WAC resulting from mixing within each cell. This practice was the original intent and basis of the WAC. The WAC of the OSDF will be applied by using contaminant-of-concern-specific average concentration within each cell; therefore, materials acceptance for disposal within the OSDF would be based on the overall average concentrations of contaminants within the cell meeting WAC instead of the not to exceed limits. The change in the application of the WAC will result in the OSDF being protective at a risk level of 1×10^{-5} which will continue to be fully protective of human health and the environment (See Figure 4.1b2).

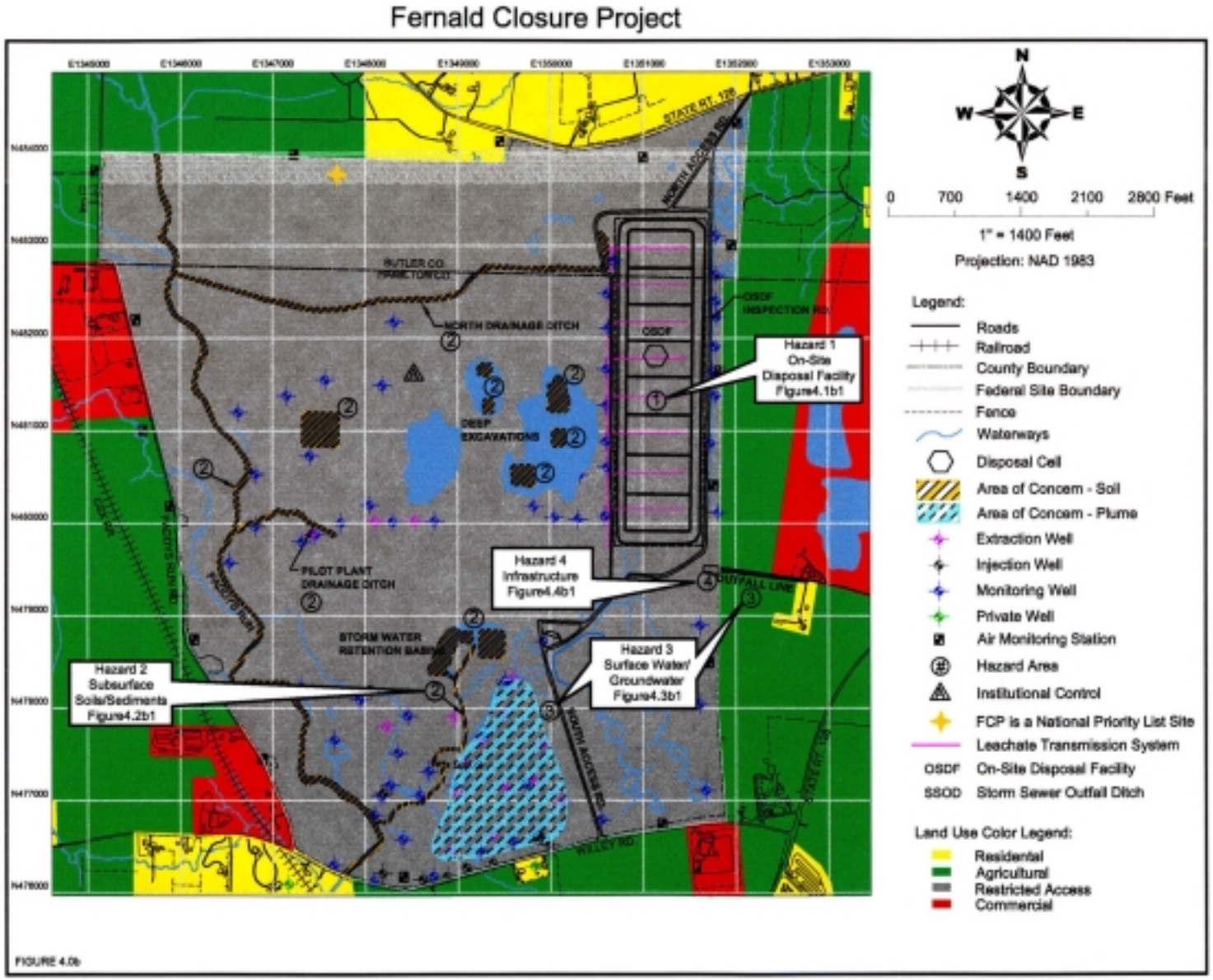


Figure 4.0b. Site wide hazard map – RBES.

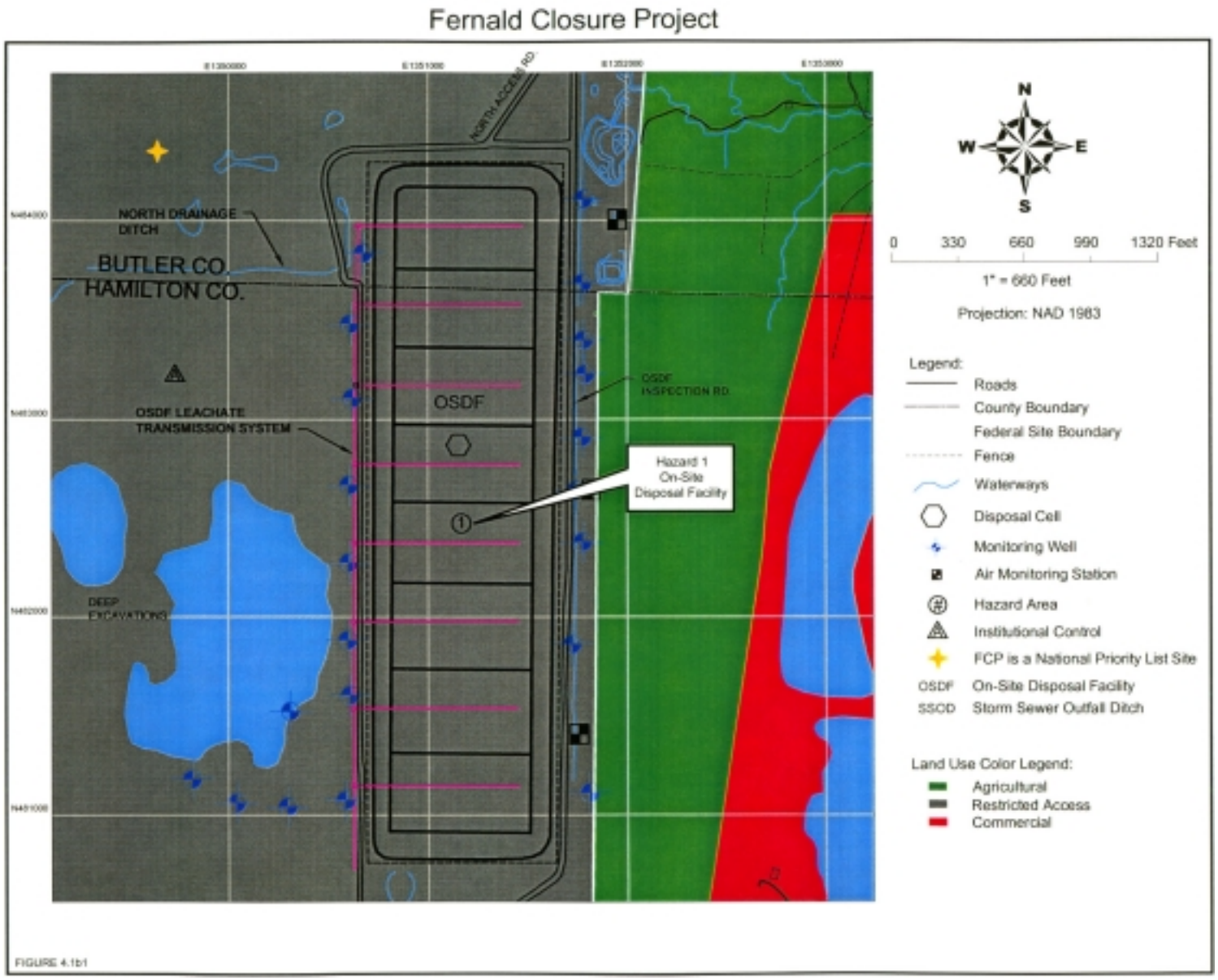
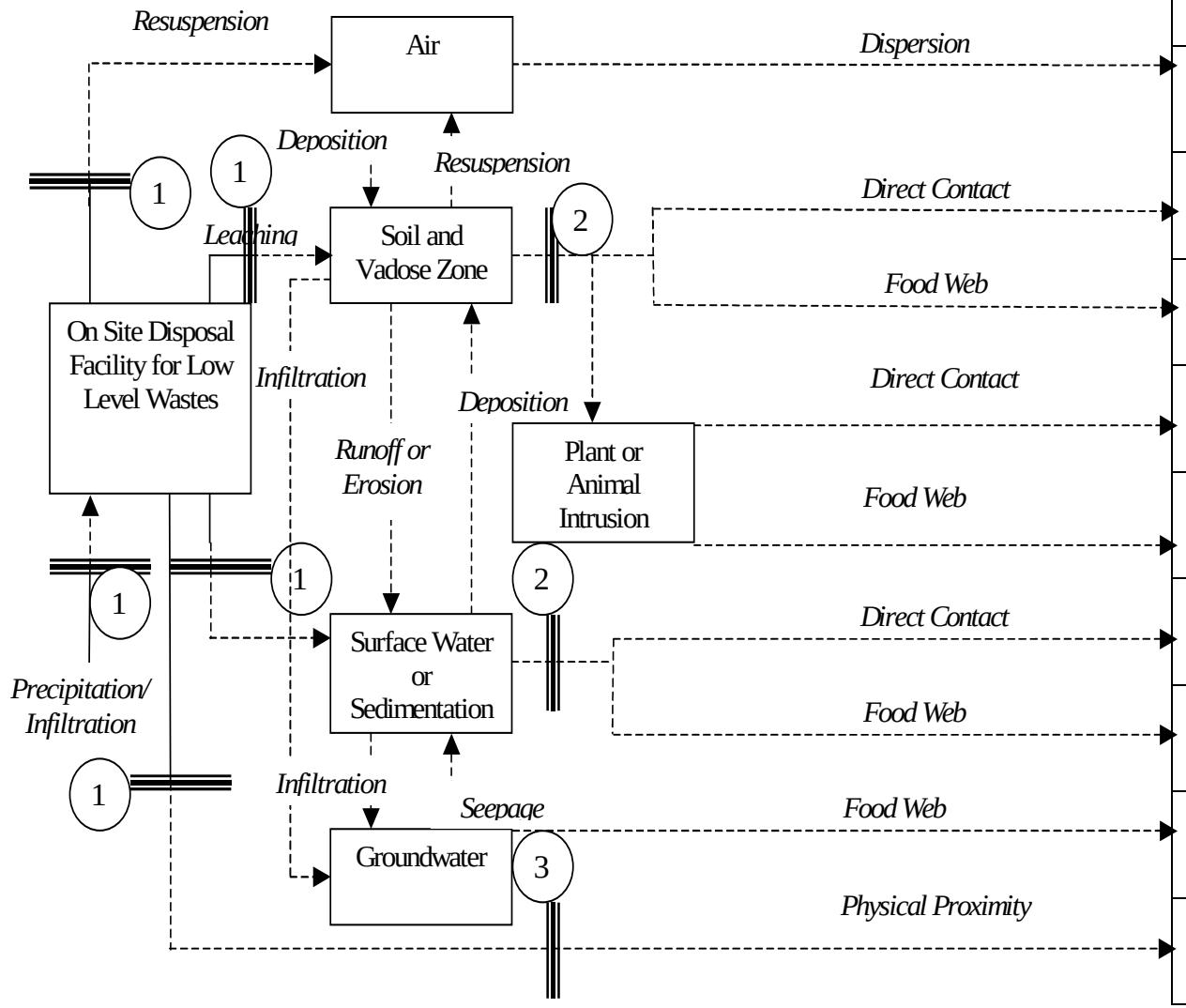
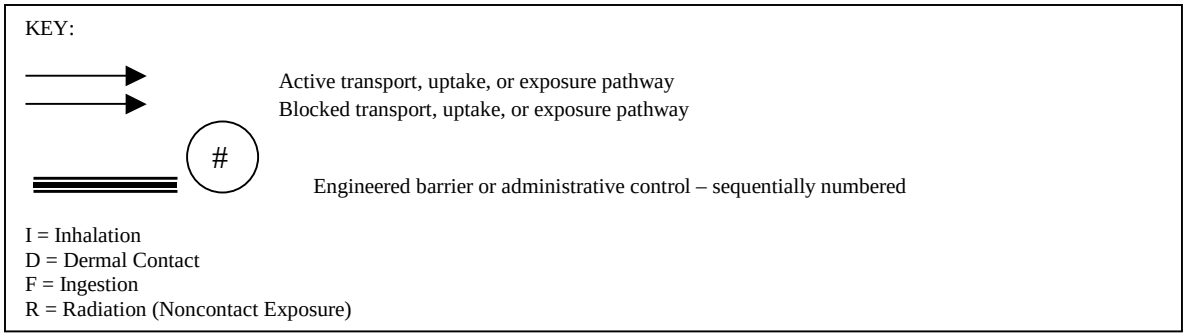


Figure 4.1b1. Hazard Area 1 OSDF map – RBES.

Figure 4.1b2. Hazard Area 1 OSDF CSM – RBES.



Potential Receptor Exposed		
Visitor	Worker	Ecological
I	I	I
R/D	R/D	R/D
F/R	F/R	F/R/D
R/D	R/D	R/D
F	F	F/R/D
	D	F/D
F	F	F/D
F	F	F/D
R	R	R



Narrative – Potential Release Mechanisms
This is a simplified conceptual model of potential environmental release mechanisms and exposure pathways for the OSDF containing soil, debris, concrete, metal with a high volume but low content of uranium, metals, and/or other long lasting contaminants. While no release to the environment is assumed, this model considers potential release and exposure pathways.

The potential release mechanisms to the environment are (a) resuspension of contaminated particulate matter, (b) surface runoff, (c) leakage or leaching to subsurface soils from the facility, and (d) rupture of cap from settlement, plant intrusion, animal burrowing or erosion. Besides release through primary mechanisms, the contaminants introduced into the environment are likely to flow between different environmental media such as air, surface soil, surface water and groundwater due to interconnecting mechanisms such as runoff, deposition, infiltration, etc.

Based on these complex interconnecting transport mechanisms, potential human exposure mechanisms are: ingestion of plants grown using contaminated water; consumption of possibly contaminated fish and wildlife; direct contact with contaminated soils; possibly inhalation of resuspended particulate matter; and physical proximity to gamma emitting radionuclides. In addition to exposure pathways associated with environmental releases, direct exposure due to inadvertent intrusion is also considered as a significant hazard.

The potential ecological exposure mechanisms are likely to be ingestion of contaminated water, ingestion of plants grown using contaminated water, secondary ingestion of aquatic organisms that uptake contaminants through sediments or water, direct contact with contaminated soils, and inhalation of vapors or suspended particulate matter. There may also be a possibility of direct exposure to gamma emitting radionuclides due to inadvertent intrusion.

Narrative – RBES Barriers/Interventions
The steps taken to mitigate potential exposures are as follows:

1. The OSDF is constructed with a composite liner and cap of soil and geosynthesis. The liner has leak detection and leachate collection and transmission systems.
2. Periodic inspections and maintenance of the final cover will occur as well as periodic monitoring and maintenance of the leak detection system and groundwater monitoring system to ensure the protection of human health and the environment.
3. A buffer zone and perimeter fence will be established around the OSDF to restrict access to the public. The OSDF and buffer zone property will remain in DOE ownership in perpetuity. In the event that DOE transfers management of the OSDF to another federal government entity, the appropriate restrictions and limitations will be communicated and implemented (e.g., deed restrictions).

All below WAC Resource Conversation and Recovery Act (RCRA) soil and the Silos debris will be disposed of in the OSDF.

The OSDF leachate with an approximate flow rate of 1 gallons per minute (gpm) will be discharged to surface water bodies in the former production area without further treatment as long as all the surface water FRLs are met. Surface water FRLs meet the MCL for drinking water and will have no impact on human or ecological receptors. Directly discharging the OSDF leachate could contribute to an earlier removal of the Advanced Wastewater Treatment Facility.

The 1-gpm flow of leachate will not likely impact the overall ability of the surface water to meet FRLs so implementing the RBES Vision will continue to be fully protective of human health and the environment**.**

4.2 HAZARD AREA 2 – SUBSURFACE SOILS/SEDIMENTS

Background

Following 37 years of operations, air deposition, and waste disposal activities, Fernald soil and debris became contaminated with radionuclides and chemicals at levels that necessitated remediation. As required by the OU2 and OU5 RODs, contaminated soil above negotiated cleanup levels is being excavated. The site areas requiring excavation cover 400 acres and include the Lime Sludge Ponds, Southern Waste Units, and soil under the Waste Pits and Silos. Surface soil FRLs are being used for the remediation of all soil on the FCP (DOE, 1998). Excavated soils are properly disposed on site in the OSDF if they meet OSDF WAC or at an off-site disposal facility.

Surface soil FRLs were developed considering the potential for the inhalation of soil. The use of surface soil FRLs for streams, ponds and other open water areas is considered very conservative because the inhalation pathway will be eliminated or greatly reduced due to the ongoing presence of water. The use of sediment FRLs was contemplated in the ROD, but their specific application was not defined.

RBES

Sediment FRLs (210 ppm uranium) will be applied to all streams, ponds, and other excavations targeted for future ponds and open water (See Figure 4.2b1). Streams and ponds do not have the same exposure pathways as soil areas, due to water coverage. Sediment FRLs applied to streams and ponds will be protective of human and ecological receptors.

The soil FRL takes into account the inhalation pathway and is therefore lower than the sediment FRL, which assumes no inhalation pathway. The ponds and open water will have permanent water coverage resulting in no change in risk, due to use of the sediment FRLs. Paddys Run does dry up in the late summer months, but controls (e.g., gates or ropes and signs) will be placed at access locations to keep people from utilizing the streambed in unallowable ways (e.g., motorcycles, ATVs).

Cross-Media Preliminary Remediation Goals (CPRGs) will be applied to subsurface soil instead of surface soil FRLs. This will reduce overall excavation of subsurface soils that have no surface exposure pathways. Soils removed during deep excavation of below grade structures will be segregated and used for backfill, as long as soil FRLs or CPRGs are met.

The use of the CPRGs will continue to be fully protective of the Recreational User of the site (See Figure 4.2b2). Any soil that meets CPRGs will be buried, eliminating the exposure pathway to any soil that is above soil FRLs.

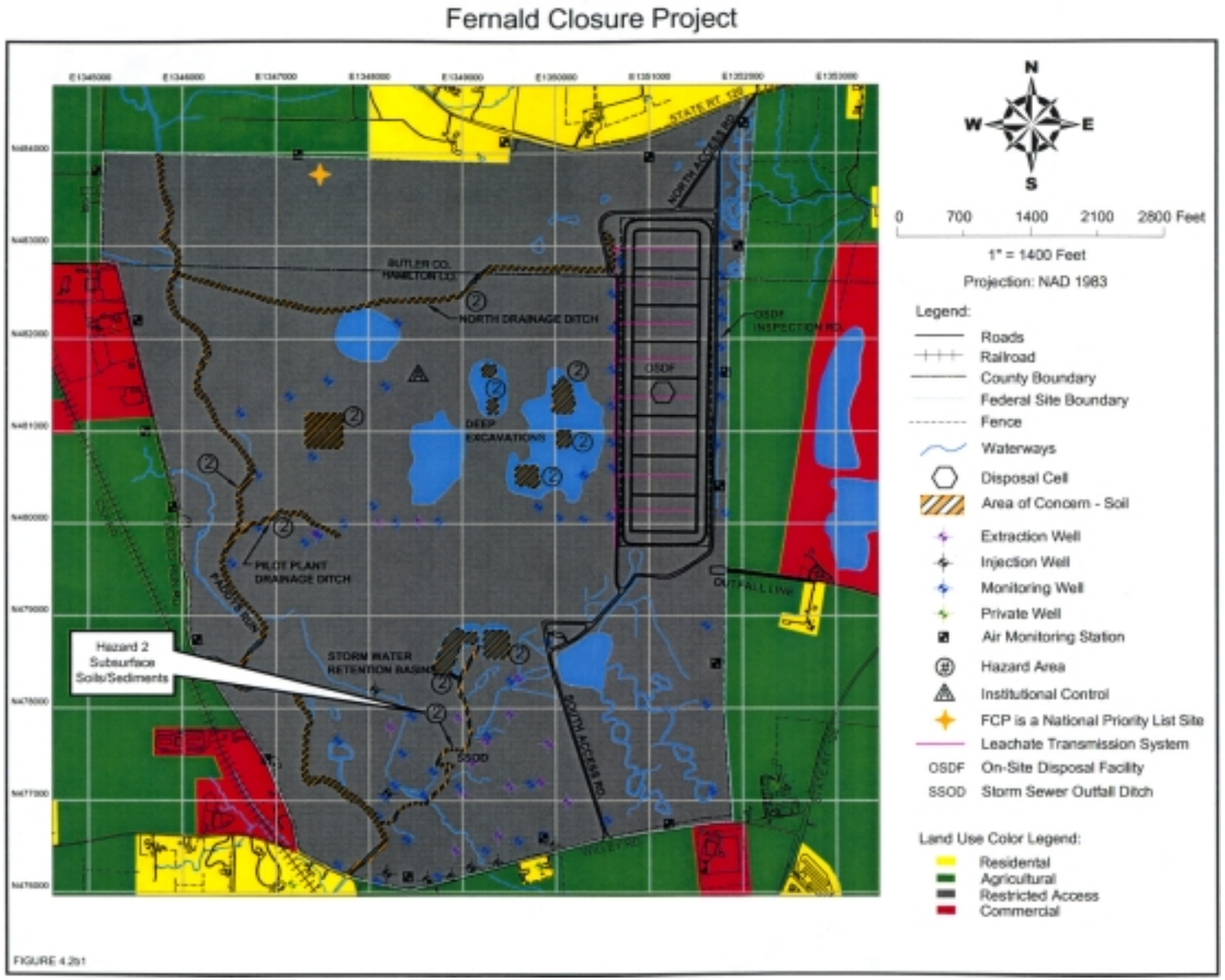
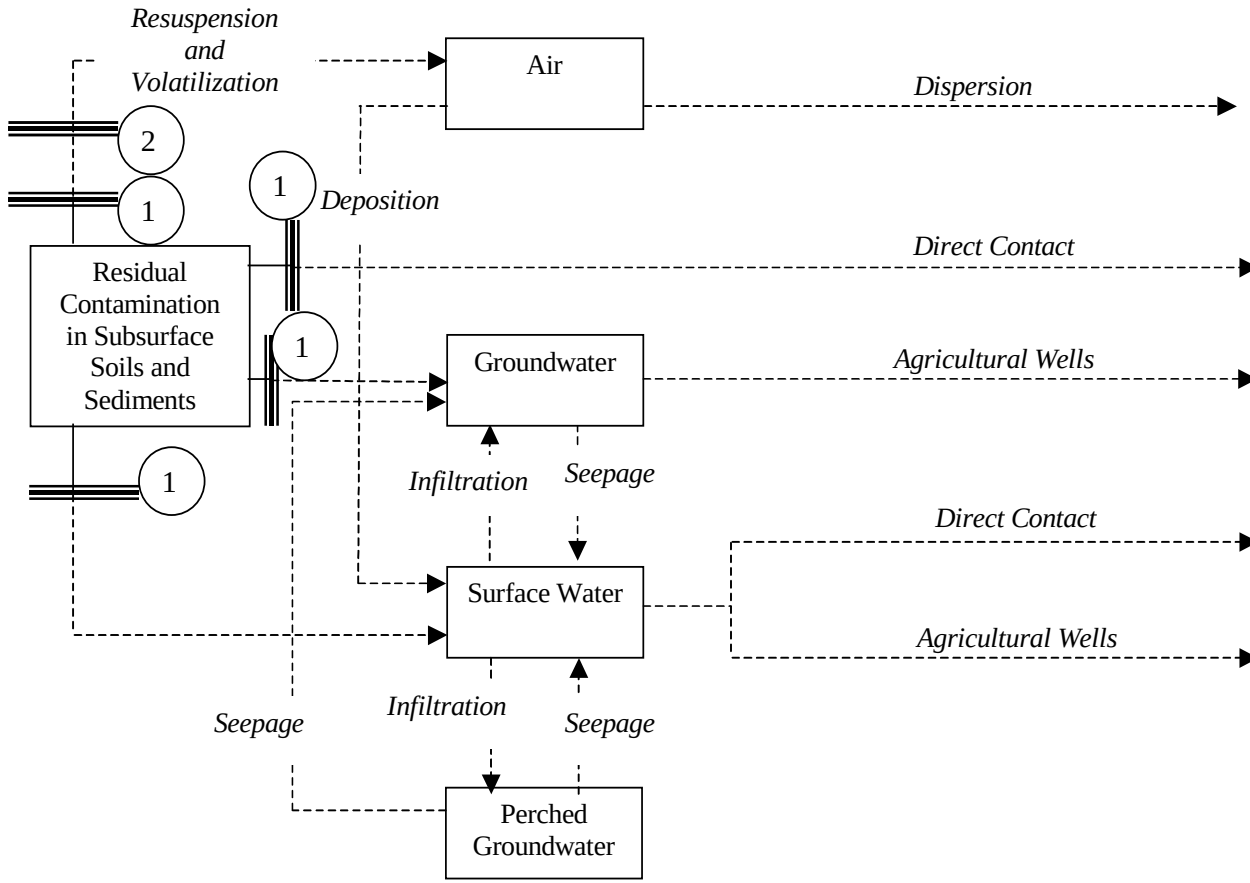
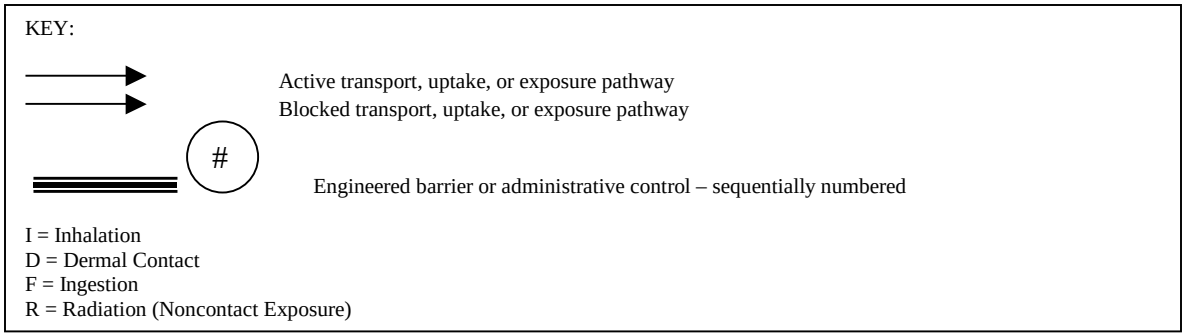


Figure 4.2b1. Hazard Area 2 subsurface soils/sediments map – RBES.

Figure 4.2b2. Hazard Area 2 subsurface soils/sediments CSM – RBES.



Potential Receptor Exposed		
Visitor	Worker	Ecological
I/D	I/D	I/D
F/D	F/D	F/D
		F
F/D	F/D	F/D
		F



Narrative – Potential Release Mechanisms
This is a simplified conceptual model of the potential environmental transport and exposure pathways for residual contamination at Fernald. While no release to the environment is assumed, this model considers potential release and exposure pathways.

The potential predominant release mechanisms to the environment are (a) resuspension of contaminated particulate matter, (b) volatilization of exposed chemical residuals, (c) erosion and surface runoff to surface water bodies, and (d) leaching of residual contamination into groundwater. No commercial, agricultural, or residential use of water is envisaged. Besides release through primary mechanisms, the contaminants introduced into the environment are likely to flow between different environmental media such as air, surface soil, surface water and groundwater due to interconnecting mechanisms such as runoff, deposition, infiltration, etc.

Based on these interconnecting transport mechanisms, potential human exposure mechanisms are: inhalation of volatilized vapors and resuspended particulate matter, and direct contact with contaminated soil or surface water. Groundskeepers, because they are at the site on a regular basis, would have the highest potential for exposure.

The ecological exposure mechanisms are likely to be inhalation of volatilized vapors and resuspended particulate matter, ingestion of contaminated water, ingestion of plants grown using contaminated water, secondary ingestion of aquatic organisms that uptake contaminants through sediments or water, direct contact with contaminated soils or water.

Narrative – RBES Barriers/Interventions
The steps taken to mitigate potential exposures are as follows:

1. Soils remaining in streams, ponds, and excavations targeted for future ponds and open water will meet the sediment FRL of 210 ppm uranium. Subsurface soils will meet CPRGs.
2. Sediments and subsurface soils are covered by water and surface soil, respectively; therefore, there is no pathway to air and no risk of exposure by inhalation.
3. Intervention - The FCP site will remain federal government property with limited public access for educational purposes.

4.3 HAZARD AREA 3 – SURFACE WATER/GROUNDWATER

Background

Fernald is located over the Great Miami Aquifer, one of the largest sources of drinking water in the nation. Following years of uranium production, the aquifer became contaminated with uranium. The levels of uranium in the groundwater are above the drinking water standard of 30 parts per billion (ppb) set by U.S. EPA. Through the Aquifer Restoration subproject, the contaminated portion of the aquifer will be restored by reducing the uranium concentration level to the drinking water standard.

The OU5 ROD documents DOE's commitment to restore the Great Miami Aquifer within 27 years (DOE, 1996b). The remedy is currently being accomplished by pumping the contaminated on-site and off-site groundwater plume from beneath 179 acres, and treatment at the Advanced Wastewater Treatment (AWWT) Facility until the combined, extracted groundwater is less than the ROD established discharge limits for uranium. These limits are 30 ppb on a monthly average and 600 pounds annually in the Site's effluent discharge to the Great Miami River. Although not required by the ROD, DOE is currently utilizing re-injection to enhance the remedy. The AWWT, with a combined groundwater and wastewater treatment capacity of approximately 2500 gpm, is projected to operate beyond the 2006 Closure date under the current state. Waste generated from the D&D of the AWWT and the remediation of the underlying soil will require off-site disposal under current plans.

Current groundwater modeling indicates that the groundwater FRL for uranium (30 ppb) would be achieved site wide by 2023, with the off-property portion of the South Plume falling below the FRL in 2013. The estimated life cycle cost for this alternative is $167.8 million with the estimated cost through the June 30, 2006 target closure date at $27.2 million (DOE, 2003b). Appendix C provides additional information regarding the complexities of the surface water/groundwater issues related to both the current state and the RBES remedy.

The Sitewide Ecological Risk Assessment (SERA) (DOE, 1995a) investigated risks to aquatic ecological receptors in the Great Miami River by comparing surface water contaminant concentrations to Benchmark Toxicity Valves (BTVs). This effort revealed that several Constituent of Ecological Concerns (COECs) warranted further investigation. The subsequent re-evaluation of ecological risks in the Sitewide Excavation Plan (SEP) concluded that three parameters (barium, cadmium, and silver) should be added to the IEMP surface water sampling program (DOE, 1998). Results of this effort have revealed that of 359 samples, only six BTV exceedances have occurred since 1997. Five of the six exceedances were for cadmium, which has a BTV lower than the Great Miami River background concentration. DOE and USEPA/OEPA subsequently agreed to eliminate most BTV-driven surface water sampling due to the extremely limited number of exceedances. Therefore, surface water COECs in the Great Miami River are not an issue.

RBES

Full restoration of the aquifer, to meet the uranium drinking water standard of 30 parts per billion (ppb), would occur both on-site and off-site (see Figure 4.3b1). Meeting the drinking water standard will address risk issues related to human and ecological receptors both on-site and off-site (see Figure 4.3b2). The AWWT facility will be modified to retain 1800 gpm of the existing 2600 gpm capacity. This will allow early D&D of 90% of the existing AWWT footprint (soil and debris) and placement into the on-site disposal facility. This alternate treatment would not require formal changes to the OU 5 ROD or associated regulatory permits. Discharge limits would be accomplished primarily by adjusting groundwater pumping rates when necessary and terminating groundwater re-injection without significantly delaying the aquifer restoration time frame. Based on the observed progress of aquifer restoration, it is expected that no significant change in the groundwater remediation schedule would occur under the conceptual RBES remedy.

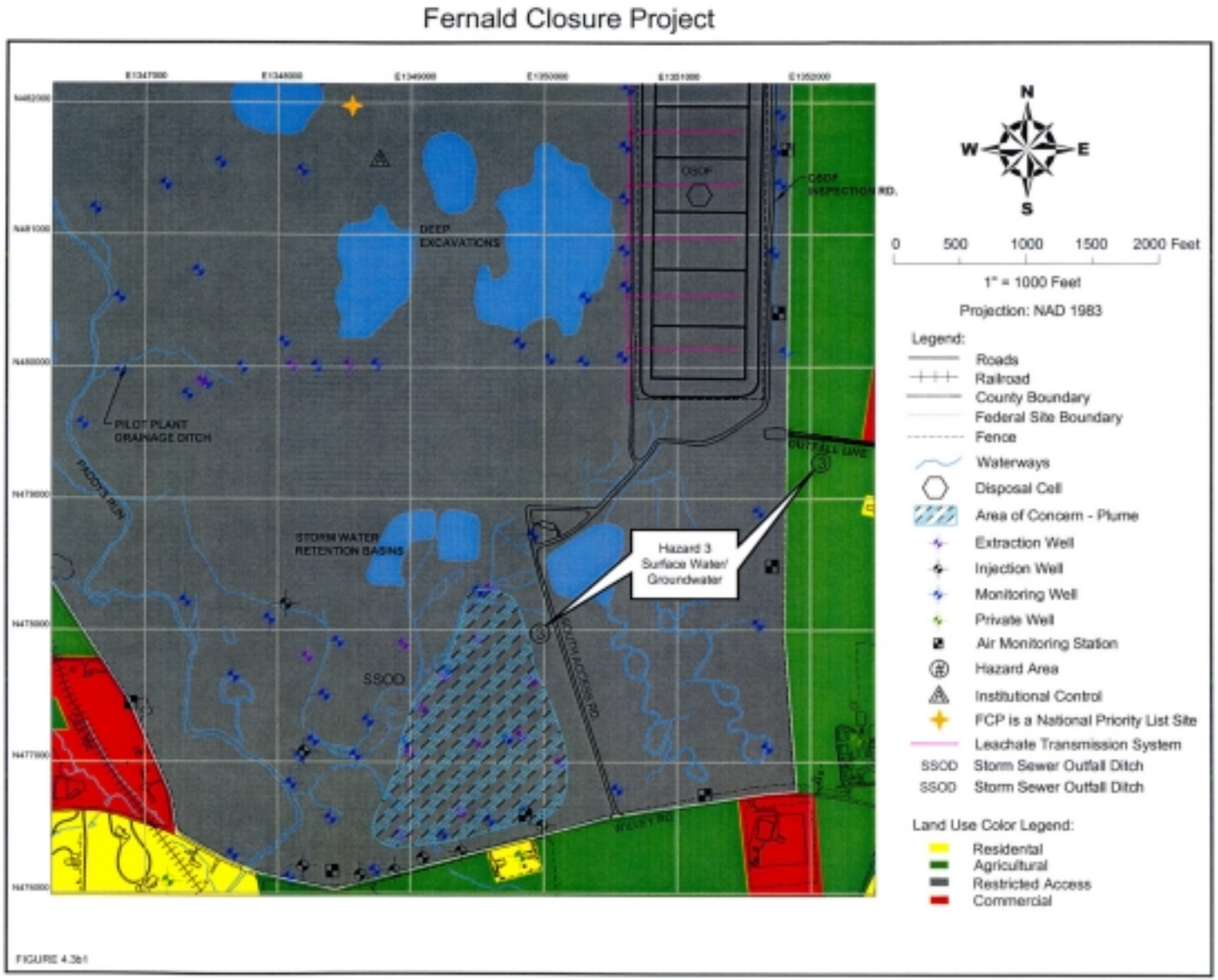


Figure 4.3b1. Hazard Area 3 surface water/groundwater map – RBES.

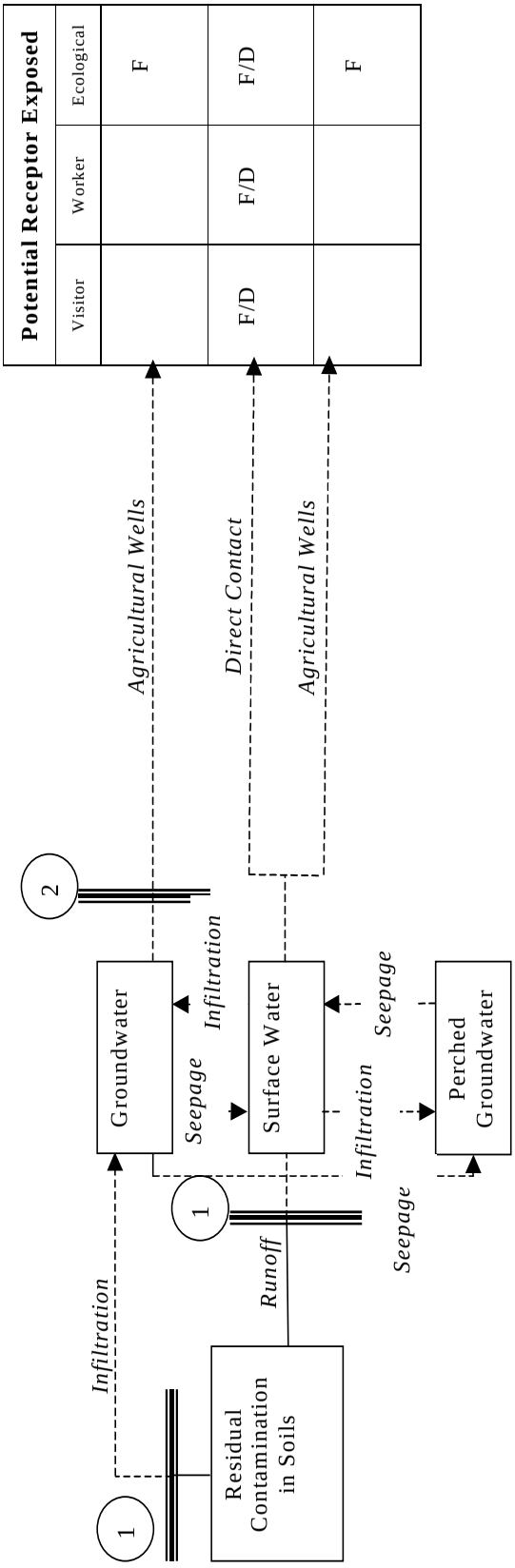
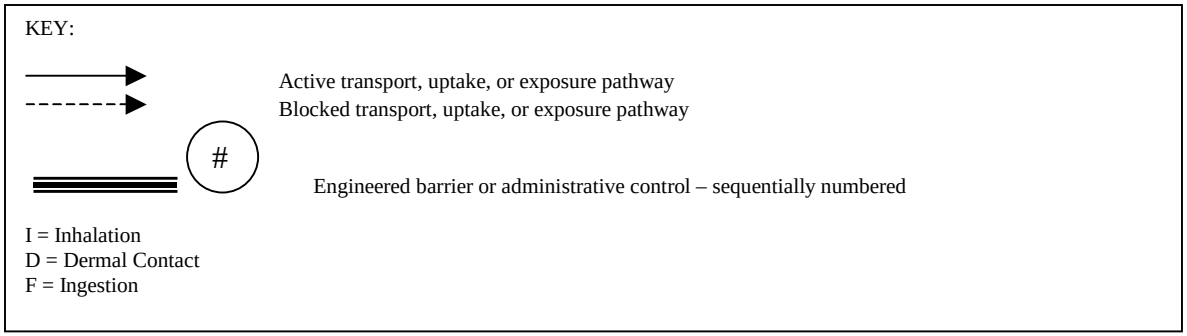


Figure 4.3b2. Hazard Area 3 surface water/groundwater CSM – RBES.



Narrative – Potential Release Mechanisms

This is a simplified conceptual model of potential environmental transport and exposure pathways for uranium contaminated surface water and groundwater. While no release to the environment is assumed, this model considers potential release and exposure pathways.

The primary source of contamination to the surface water and groundwater is the residual contamination in the soils. Treatment of the groundwater plume will consist of pumping the existing extraction wells, blending the flows from the wells with untreated storm water and remediation wastewater, and discharging the blended flow to the Great Miami River. Discharging will continue until the plume has met groundwater FRLs.

The potential predominant release mechanisms of contaminants in wastewaters to the environment are (a) infiltration of surface water to groundwater and perched groundwater and (b) seepage from perched groundwater to surface water, perched groundwater to groundwater, and groundwater to surface water.

The potential exposure mechanism to the Recreational User is direct contact with and ingestion of surface water.

The potential exposure mechanism to ecological receptors is ingestion of contaminated well water and direct contact with surface water.

Narrative – RBES Barriers/Interventions

The steps taken to mitigate potential exposures are as follows:

1. Monitoring of the discharge stream to the Great Miami River will continue to ensure that the stream meets the ROD based discharge limits.
2. Use of contaminated groundwater off site will be prohibited until the plume meets the U.S. EPA Drinking Water Standard for uranium of 30 ppb.
3. Intervention - The FCP site will remain federal government property with limited public access for educational purposes.

4.4 HAZARD AREA 4 – INFRASTRUCTURE

Background

The OU2 and OU5 RODs require the excavation of contaminated soil above negotiated cleanup levels. The site areas requiring excavation cover 400 acres. In addition to contaminated soil, building foundations, concrete storage pads, parking lots, roads, and below-grade piping will be removed as part of soil excavation.

RBES

The Silos Treatment Facility and TTA structures were installed clean. The above grade concrete debris from D&D of the buildings will be certified clean and provide clean, hard fill for select deep excavations (see Figure 4.4b1). Deep excavations targeted for clean, hard fill include the main storm sewer line under the main parking lot and other select excavations. Excavations can be completely or partially filled with no impact on site restoration plans.

All clean rock and debris currently in Paddys Run will be left alone (rip rap at Silos, concrete support at railroad trestle). The stream corridor will be certified clean and leaving the debris in place will not increase risks to receptors.

The new outfall line will be cleaned and abandoned in place. The new outfall line is constructed of high-density polyethylene (HDPE) and can be cleaned on the inside to eliminate the risk of contaminants leaching into surrounding soils. Abandoning it in place will save construction costs associated with excavation of the lines.

Implementing the RBES Vision will continue to be fully protective to human health and the environment (See Figure 4.4b2).

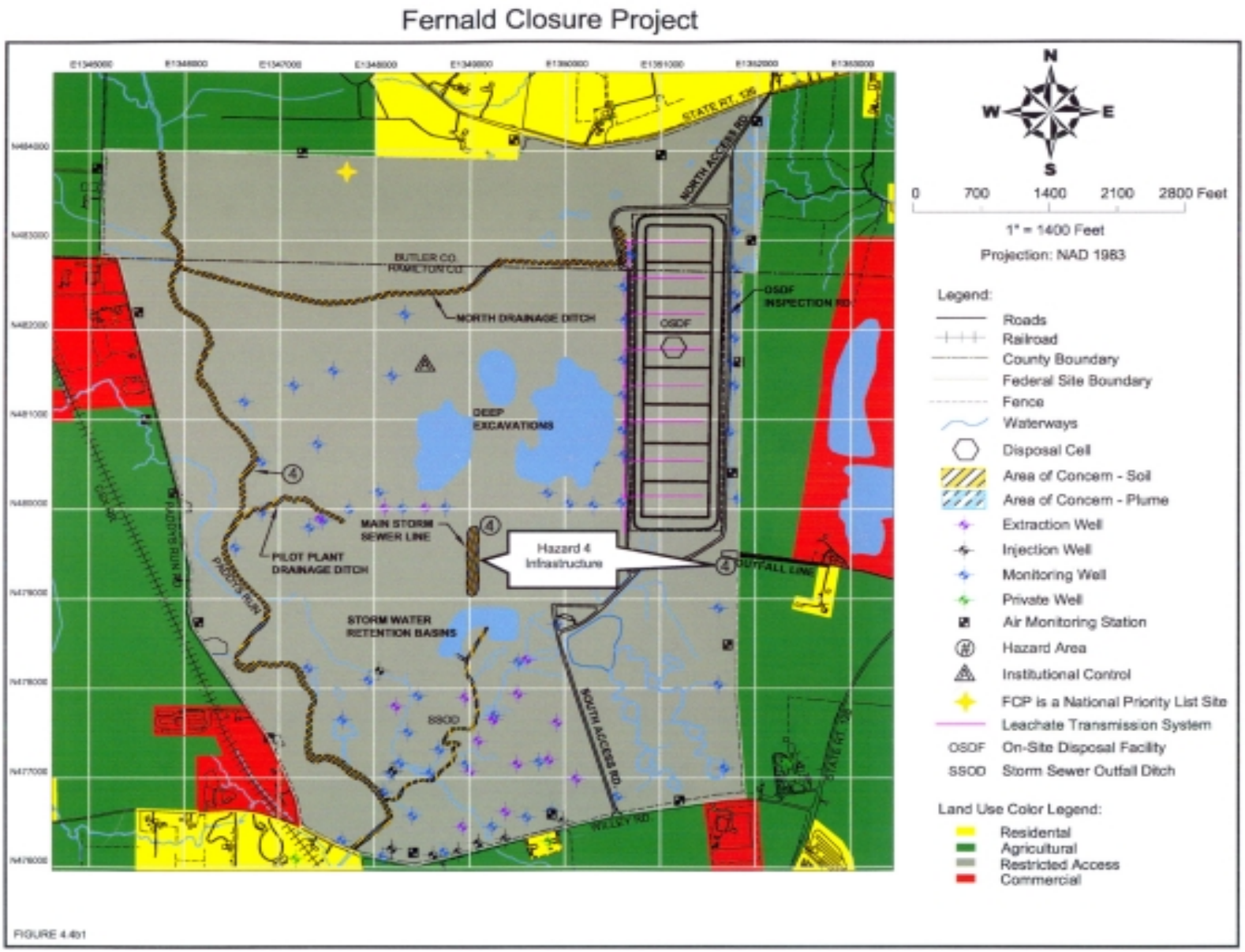
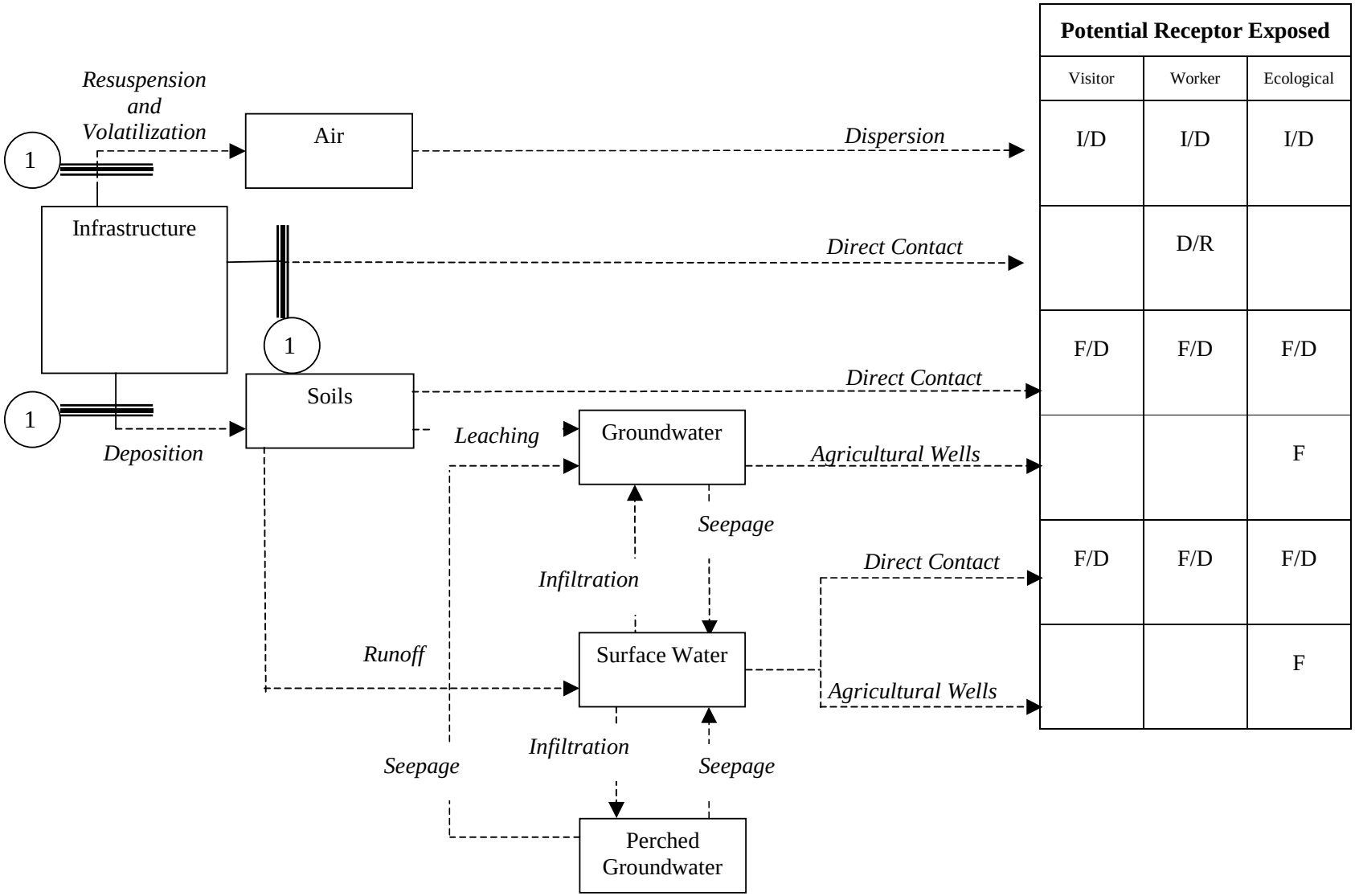
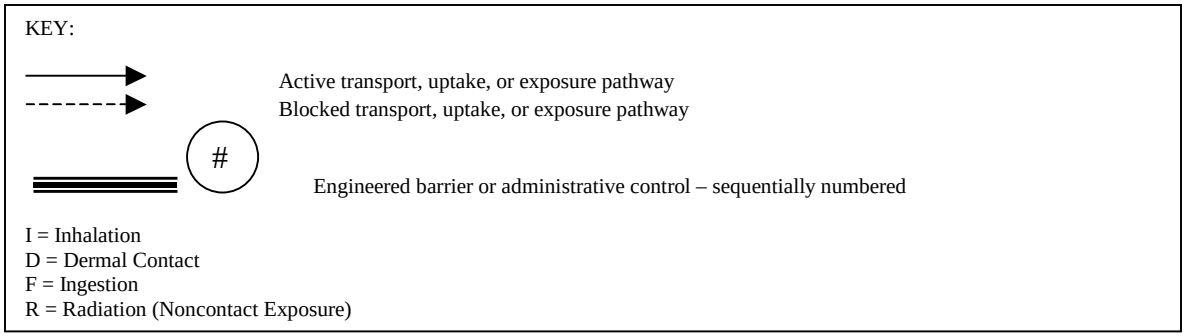


Figure 4.4b1. Hazard Area 4 infrastructure map – RBES.

Figure 4.4b2. Hazard Area 4 infrastructure CSM – RBES.



Potential Receptor Exposed		
Visitor	Worker	Ecological
I/D	I/D	I/D
	D/R	
F/D	F/D	F/D
		F
F/D	F/D	F/D
		F



Narrative – Potential Release Mechanisms
This is a simplified conceptual model of the potential environmental transport and exposure pathways for infrastructure left on site. The new outfall line, will be cleaned and abandoned in place. The D&D concrete debris from clean structures will be certified clean and used as clean, hard fill in select deep excavations. Institutional controls will ensure that the new outfall line and clean concrete debris are not excavated or removed. While no release to the environment is assumed, this model considers potential release and exposure pathways.

The potential predominant release mechanisms to the environment are (a) resuspension of contaminated particulate matter, (b) volatilization of exposed chemical residuals, and (c) deposition of contaminants to the surrounding soil. Besides release through primary mechanisms, the contaminants introduced into the environment are likely to flow between different environmental media such as air, surface soil, surface water and groundwater due to interconnecting mechanisms such as runoff, deposition, infiltration, etc.

Based on these interconnecting transport mechanisms, potential human exposure mechanisms are: inhalation of volatilized vapors and resuspended particulate matter, and direct contact with contaminated soil or surface water. Groundskeepers, because they are at the site on a regular basis, would have the highest potential for exposure.

The ecological exposure mechanisms are likely to be inhalation of volatilized vapors and resuspended particulate matter, ingestion of contaminated water, ingestion of plants grown using contaminated water, secondary ingestion of aquatic organisms that uptake contaminants through sediments or water, direct contact with contaminated soils or water.

Narrative – RBES Barriers/Interventions
The steps taken to mitigate potential exposures are as follows:

1. The new outfall line will be cleaned and abandoned in place.
2. The D&D concrete debris from clean structures will be certified clean and used as clean, hard fill in select excavations.
3. Intervention - The FCP site will remain federal government property with limited public access for educational purposes.